



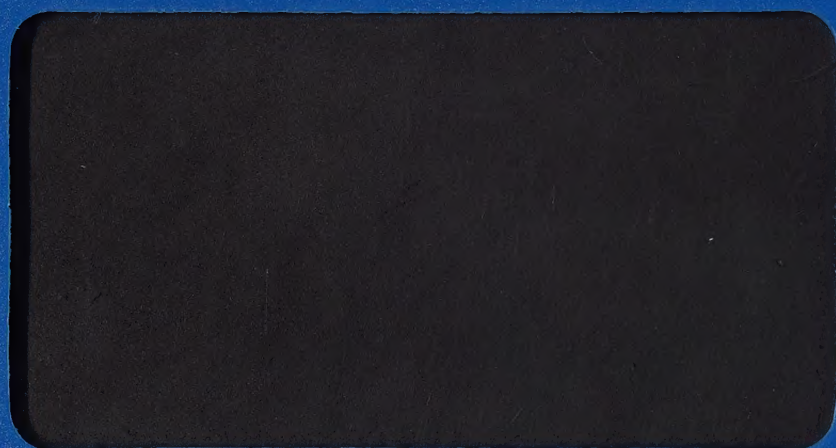
**Scientific
Atlanta**

Government Products Division

MP MASTER



MA29853



TECHNICAL MANUAL
OPERATION AND MAINTENANCE INSTRUCTIONS

MODEL GPD 351A
TRANSLATOR
(Part Number 40214500)

SCIENTIFIC-ATLANTA
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SAFETY SUMMARY**GPD 351A ANALYZER SYSTEM****1. GENERAL**

The following are general safety precautions that are not related to any specific procedures and therefore do not appear elsewhere in this technical manual. It is the user's responsibility to understand and apply these safety precautions during all phases of operation, service, and repair of this system. Failure to comply with these precautions or with specific warnings elsewhere in this technical manual violates safety standards of design, manufacture, and intended use of this system.

2. GROUND THE SYSTEM

To minimize shock hazard, system chassis and equipment cabinet must be connected to an electrical ground. The GPD 351A is equipped with a three-conductor AC power cable. This power cable must be installed in accordance with installation procedures provided.

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ASSOCIATED MANUALS

- A. Schematic Set - Document No. 402151
- B. GPIB Interface Document - Document No. 401059



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Figure 1.1 Model GPD 351A Translator

SECTION I

GENERAL INFORMATION

1.1 Introduction

The GPD 351A Translator is designed for use with the GPD 350-6A Digital Signal Analyzer. Its purpose is to enhance the utility of the GPD 350-6A by extending the frequency range of the input analog signal to 6 MHz. The GPD 351A also provides GPIB capability for both the 351A controls and the 350-6A controls. Figure 1.2 is a simplified block diagram of the translator. The translator is designed for mounting in a standard 19-inch rack and is provided with three 6-foot cable assemblies for interconnecting the GPD 351A and the GPD 350-6A.

1.2 Characteristics

The following features are provided by the GPD 351A.

- a. Sixteen front panel selectable ranges.
- b. Center frequency selection in 1 Hz steps.
- c. Indication of input signal level meter and overload.
- d. Selectable 50 ohm/1000 ohm input termination,
- e. Built-in test signal.
- f. "Enabled" LED to show proper GPD 350-6A switch settings.
- g. Built-in GPIB interface.

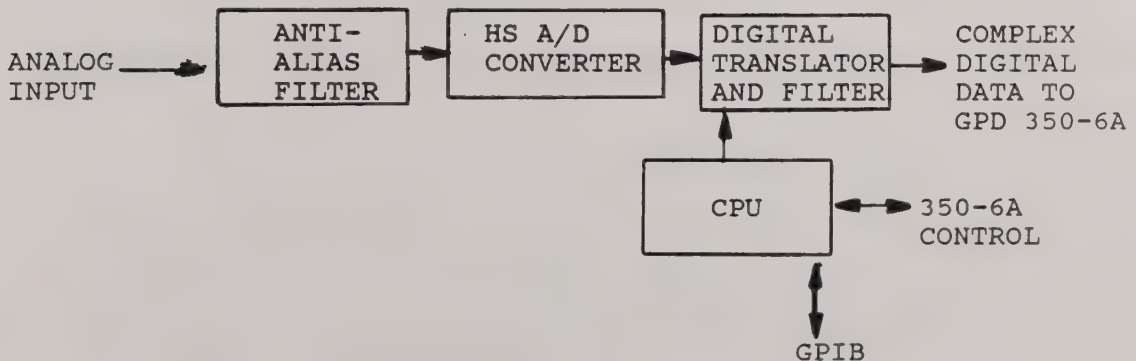


Figure 1.2. Model GPD 351A Simplified Block Diagram

1.3 Front Panel Functional Description

Figure 1.1 is a front view of the GPD 351A Translator. The front panel controls and indicators provide the following operational functions.

POWER Pushbutton/Indicator - Applies primary power to PS1. Illuminated when ON.

ENABLED (LED) - Indicates that the 350-6A switches are properly set for 351A control. They are:

- a. Range to EXT
- b. Expand to OFF/EXT
- c. % Range to 00.0/EXT
- d. Magnify to EXT

INPUT TERMINATION - The input is terminated with a selectable 50 ohms or 1000 ohms. Note that the unit measures signal level at the input, so with a finite source impedance, the input termination does effect input level.

OPERATE/TEST SELECTOR - The input remains terminated, but a test signal is substituted for the input. The test signal is a 245760 Hz pulse train so all harmonics of this signal are present.

INPUT GAIN - Provides additional gain for the input of 5, 10, and 15 dB.

SIGNAL LEVEL METER - Indicates the relative amplitude of the input signal. Red zones at the ends of the meter scale indicate a "too high" or "too low" input.

OVERLOAD (LED) - Indicates limiting of the A/D converter.

RANGE (KHz) - Selects the analysis frequency range. Operable when the Enabled LED is on.

TRANSLATE ON/OFF - OFF: The range is from dc to the range frequency selected.

ON: The range is centered about the center frequency selected.

CENTER FREQUENCY - With Translate ON, selects the center frequency in 1 Hz steps from 0 to 7999999 Hz. (Achieved in test with SW 4 on All.) Normal operation defaults to values between one-half of the Selected Range and 6.144 MHz minus one-half of the Selected Range) when a center frequency is selected out of that limit.

CENTER FREQUENCY ERROR (LED) - Indicates that a center frequency has been selected out of the allowable limits. For normal operation, it also indicates a default substitution for the center frequency.

GPIB FUNCTIONS - Indicates certain GPIB operations and when the GPIB has placed the GPD 351A into the REMOTE mode. The LOCAL switch can request a "RETURN TO LOCAL" if the GPIB has not locked out this request. These indicators also show operations with the GPD 350-6A. Refer to the GPD 351A GPIB document for complete details.

1.4 Specifications

Input Analog

a) Frequency Ranges

*6.144 M	*4.096 M	2.4576 M
*3.072 M	*2.048 M	1.2288 M
1.536 M	*1.024 M	*614.4 K
783 K	* 512 K	*307.2 K
384 K	*256 K	153.6 K
192 K	*128 K	76.8 K
96 K	*64 K	38.4 K
48 K	*32 K	19.2 K
24 K	*16 K	9.6 K
12 K	*8 K	4.8 K
6 K	*4 K	2.4 K
3 K	*2 K	
1.5 K		

*Available for selection on front panel.

1) Center Frequency (in 1 Hz Steps)

One-half the Selected Range to (6.144 MHz - one-half the Range)

or with internal enable, 0 to 7.999999 MHz

2) Impedance

50 ohms or 1000 ohms selectable

3) Full Scale Input

100m Vrms (-20 dB/1 Vrms)

4) Anti-Aliasing Filter

+ 1/2 dB Ripple to 6.144 MHz
>60 dB stopband rejection

5) A/D Converter

10-bit

6) Sampling Frequency

Fixed at 15.72864 MHz

Output

Digital complex data compatible with GPD 350-6A.

Dynamic Range

- a) A/D distortion - dc to 2 MHz >50 dB below full scale,
2 MHz to 6 MHz >40 dB below full scale
(These terms will reflect about the sampling frequency
and appear in band.)

- b) Dynamic Range and Noise Floor: >60 dB below full scale

Power

115/230 Vac, 50 Hz to 60 Hz, 250W

Dimensions

Height	26.67 cm (10-1/2 inches)
Width	43.18 cm (17 inches)
Depth	60.96 cm (24 inches)
Weight	29.5 Kg (65 pounds)

SECTION II

OPERATION

2.1 General

This section provides instruction on the interconnection and operation procedure of the GPD 351A Translator. It is recommended that the operator become familiar with these procedures before operating the instrument. The operator must also be familiar with the applicable operating procedures of the Digital Signal Analyzer GPD 350-6A. Operation of the GPIB interface is discussed in the GPD 351A GPIB interface document.

2.2 Interconnect

The GPD 351A Translator is designed to operate with the GPD 350-6A Digital Signal Analyzer. It accepts analog signals and converts them to digital data for routing to the GPD 350-6A for analysis. Figure 2.1 shows the interconnection required for the Translator, the Digital Signal Analyzer, and the input signals.

2.3 Operation

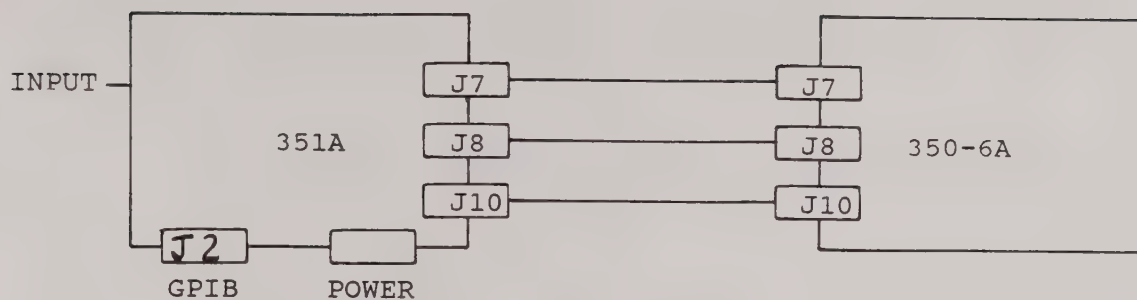
2.3.1 Power-up

Apply primary POWER to the Translator (indicator illuminated), and operate the GPD 350-6A according to its operating procedures. To enable the GPD 351A, set the following controls on the 350-6A:

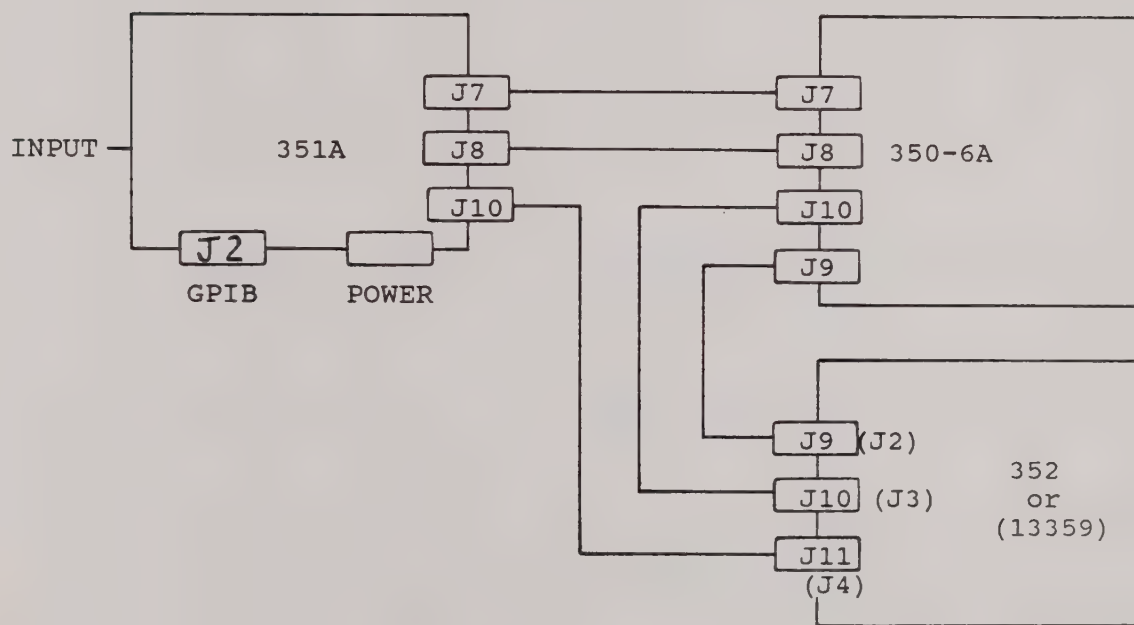
Range	EXT
Expand	OFF/EXT
% Range	00.0/EXT
Magnify	EXT

2.3.2 Operation Setup

- a. Connect the analog signal to be analyzed to the INPUT connector on the front panel.
- b. Select desired termination, place OPERATE/TEST switch to OPERATE and adjust input gain to place signal level meter to mid-span.
- c. Set Translate to OFF and set RANGE (MHz) selector to the position that includes the highest frequency to be analyzed.



(a)



(b)

Figure 2.1. 351A Interconnect Diagram.

2.3.3 Operational Checkout and Familiarization

If the completion of paragraph 2.3.2 does not result in the recognizable signal spectrum displayed by the 350-6A, then the 350-6A Operational Checkout should be performed. When completed, reset the 350-6A controls to enable the 351A.

- a. Change the input signal frequency and amplitude and verify the expected results on the spectrum display. Measure the input frequency and amplitude with the 350 -6A cursor.
- b. Lower the input frequency and select a lower frequency range on the 351A. Again measure the frequency with the 350-6A cursor.
- c. Set the cursor measured frequency on the Center Frequency switch and select translate "ON". (If the CF error LED illuminates, select a lower frequency range.)
- d. There is a momentary delay as the internal CPU "reads" the front panel and sets the internal circuits accordingly. The input signal will now appear near the center of the display and the 350-6A cursor can be used to verify the signal frequency.
- e. Change the input frequency away, and then back to the center of the display to verify operation as lower frequency ranges are selected. Note the increased frequency resolution on the lower ranges.
- f. Change the input frequency and measure it using the 350-6A cursor. Set this frequency on the Center Frequency switch and note the signal moved to the center of the display.
- g. Set the Range to 6.144 MHz and verify the Center Frequency ERROR LED illuminates. Set the Translate switch to "OFF" and set the Operate/Test switch to TEST. Verify a "picket fence" of 25 harmonics of the 245760 Hz test signal. This signal can be used for additional exercises if desired.

SECTION III

CONCEPT OF OPERATION

3.1 General

The GPD 351A is a straightforward extension of the signal processing techniques used in the GPD 350-6A. The 351A digitizes the analog input, translates it to "dc" and then low pass filters and decimates it before passing the complex data to the 350-6A for possible additional filtering and decimation and then spectrum analysis via the FFT algorithm. Refer to Figure 3.1 for a block diagram of the 351A. See also the GPD 350-6A manual and the Scientific-Atlanta application "Trigonometric Transforms."

3.2 Signal Processor

Refer to Figure 3.2.

The A/D Converter (A1) is optimized for a conversion rate of 15.72684 MHz (this will be referred to as 16 MHz and the rate divided by 2 will be called 8 MHz to save using long numbers).

An anti-aliasing filter with a corner at 6.144 MHz preceeds the A/D card. With the fixed A/D conversion rate, only one analog filter is required. A/D conversion results is a sequence of "Real" numbers. All other operations will be on complex numbers, which are handled as a pair of numbers, one representing the "Real" part and one representing the "Imaginary" (Imag) part.

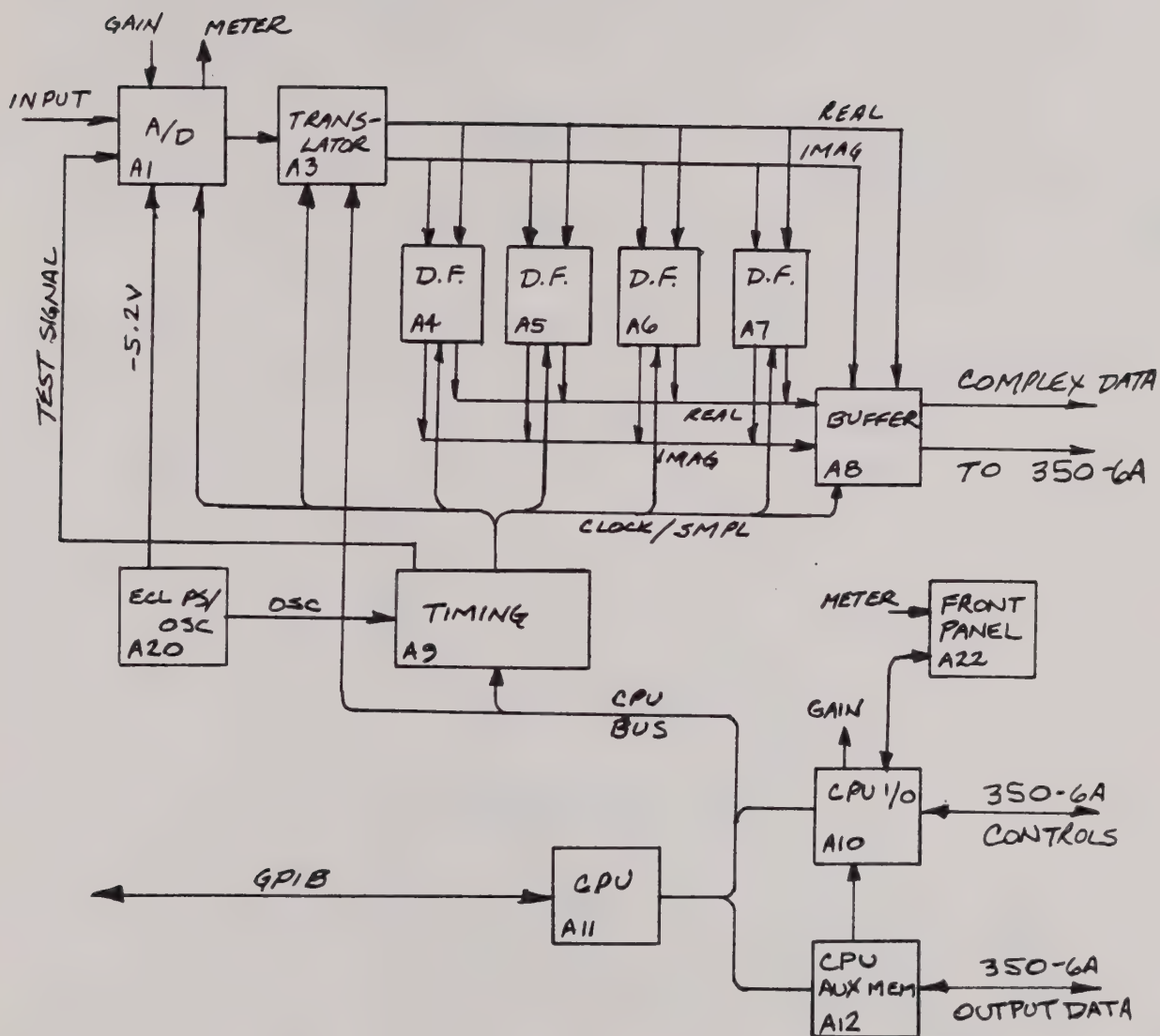
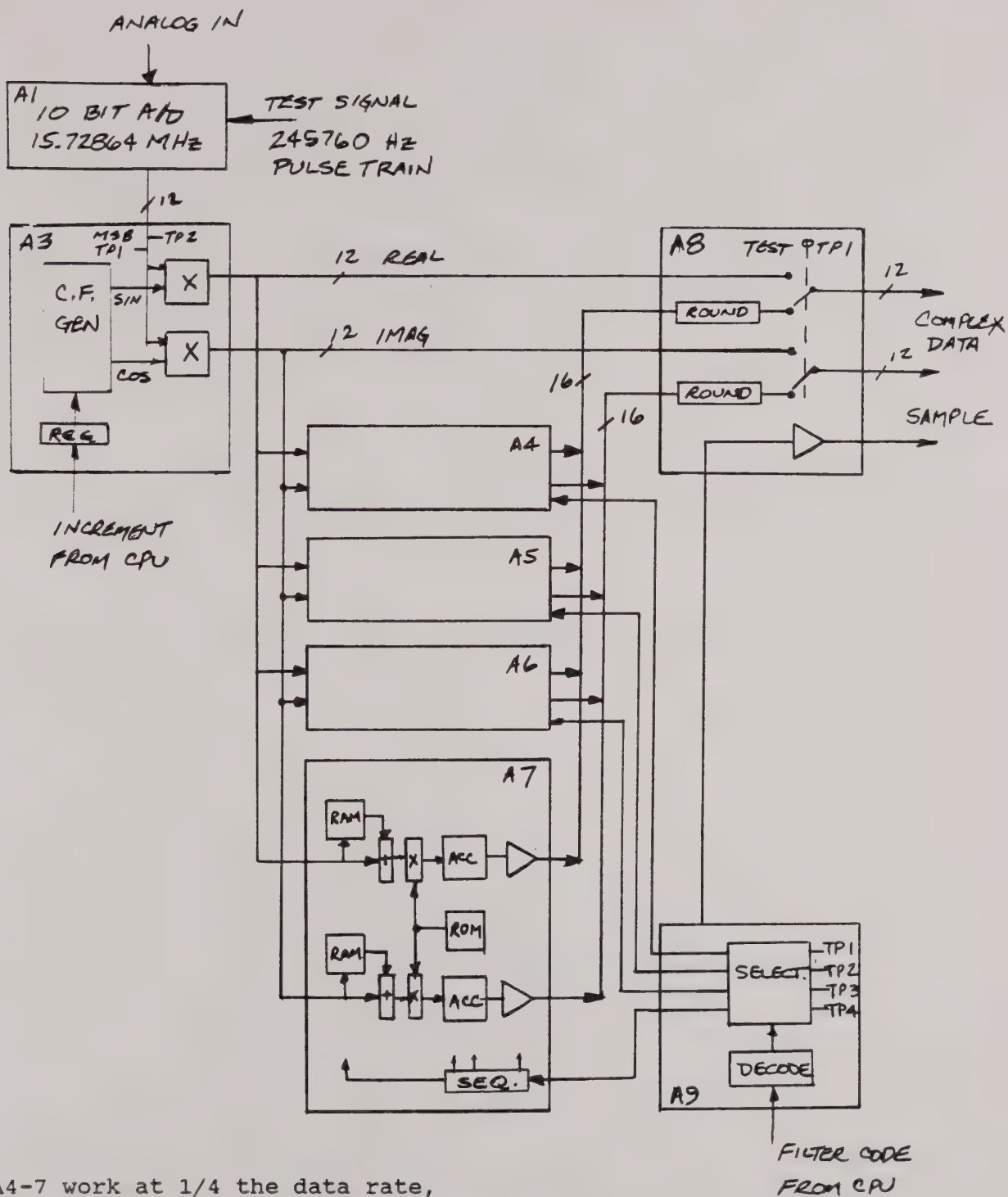


Figure 3.1. GPD 351A Block Diagram



A4-7 work at 1/4 the data rate,
A9 sequentially enables the outputs to A8.

Figure 3.2. Signal Processor

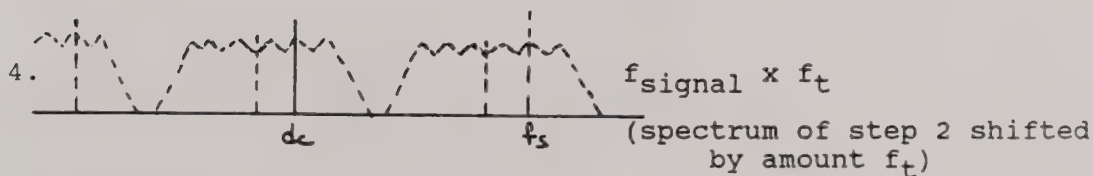
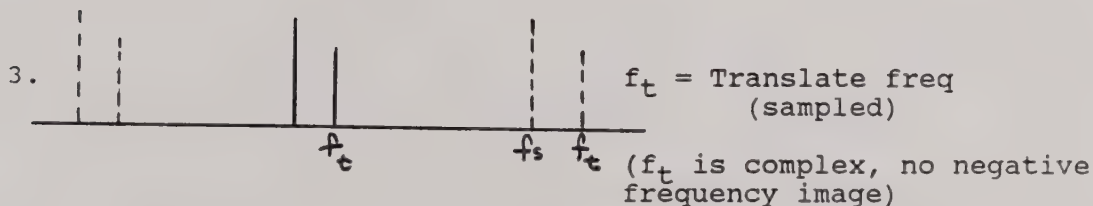
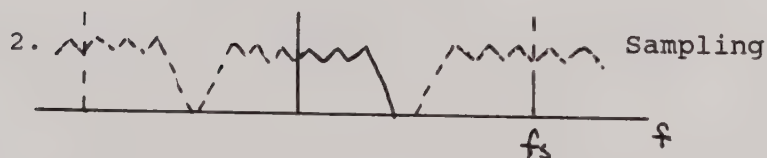
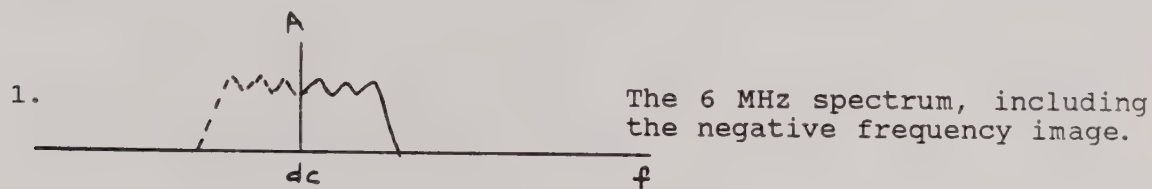
Translation is multiplication by $e^{j\theta}$

where, $\theta = \text{freq}/2$ and 'freq' is the translation frequency.

$e^{j\theta} = \cos \theta + j \sin \theta$; since the input is "Real" only 2

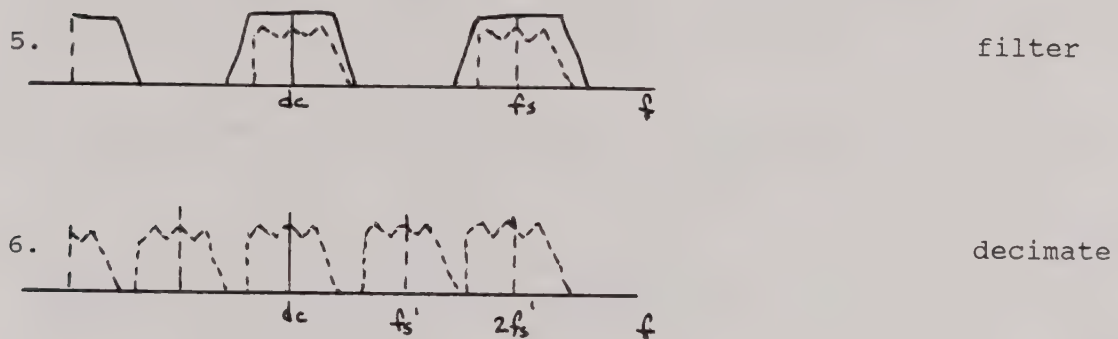
multipliers are required for the translation operation. The result of the multiplication is then separated into 2 data streams, one for the real numbers and one for the Imag numbers.

Diagrammatically, the step by step operations are:



The translate frequency is the center frequency selected. It places the center of the desired frequency band at "dc".

Since the 350-6A performs an FFT on complex data (which produces an 800-point output spectrum from 1024 complex input points), the spectrum shown in step 4 should be "compacted" to make the FFT more efficient. The desire is to lower the sampling frequency, but first the unneeded images must be removed.



Here the real data from the A/D converter, sampled at 16 MHz, is replaced with complex data sampled at 8 MHz; no data has been lost.

The filter is shown with a negative image as it is a "Real" filter. Real filters are used so that the real and imaginary data streams can be operated on separately and no cross terms are produced. The filters for the real and imaginary data are implemented with identical hardware as illustrated in Figure 3.2. Non-recursive filters are implemented, these are filters that produce an output based only on previous inputs. The reason for the filter is to band-limit the data before decimation. Using the non recursive filters means that the filter output needs to be calculated only at the desired output sample rate.

Output sample rates implemented are integer factors of the input rate. Factors of 2, 3, 4, 5, 6, 8, 10... produce output rates of 8, 5.33, 4, 3.2, 2.67, 2, 1.6 MHz. The complex FFT displays a frequency range of 80% of the sampling rate, so the produced frequency ranges for the above decimating factors are 6, 4, 3, 2.5, 2, 1.5, 1.23...MHz (2.5 and 1.23 are GPIB selections). For each decimation factor a different digital filter must be implemented. The same hardware is used; the number of coefficients and their values for each filter are stored in the Coef ROM and are selected as required.

The 350-6A also contains a digital filter to implement its zoom feature. This filter operates up to the maximum 350-6A sample rate of 820 KHz (320 KHz Range times 2.56 sampling ratio). Therefore, the 351A needs only to filter and decimate down to a sample rate of 820 KHz which minimizes the number of filters to be implemented in the Coef ROM.

3.3 CPU

The microprocessor is a standard fixed (PROM) program configuration. Its task is to monitor front panel controls, 350-6A control lines, and the GPIB. The 350-6A control lines execute at the first priority. With 'EXT' settings sensed on the frequency range and zoom controls, the CPU allows operation of the 351A controls. With all controls of the 350-6A to 'EXT', the processor will enable the GPIB function. See the GPIB document for GPIB specific information.

Microprocessor input/output is via the CPU I/O card (A10) where data is accessed on an I/O port read, and written to a register which will control a 350-6A or 351A signal processor function.

Spectrum data transfers from the 350-6A to or from the external computer are via the CPU Aux Memory (A12); implemented on A12 are memories which copy the data presented by the 350-6A during both "sweep1" and "sweep2" in both 8- and 12-bit formats. These memories are immediately available for a GPIB DMA access. Data transfer from the external computer to the 350-6A Aux Memory forces the "sweep1" memory to hold during the GPIB "listen" time and then transfers one full spectrum to the Aux Memory at completion of the GPIB transfer.

SECTION IV

CALIBRATION AND MAINTENANCE

4.1 Introduction

This section contains calibration, troubleshooting, and parts replacement information. Before performing the procedures contained in this section, become familiar with the front panel controls. It is also important to fully understand the concept of operation (Section III) before troubleshooting the instrument.

Access to the circuit cards is obtained by removal of the top slide cover. This is accomplished by removing the four corner screws and sliding the cover out towards the rear of the unit.

4.2 Calibration Procedure

The GPD 351A has been precalibrated at the factory and should not normally require calibration in the field. Some of the circuitry is extremely sensitive and calibration should not be attempted. The calibration procedure is divided into five sections and should be accomplished in the following order:

- a. Main Power Supply
- b. ECL Power Supply
- c. Crystal Osc
- d. A/D Converter Offset and Gain
- e. Meter Drive Level

4.2.1 Main Power Supply (PS1)

The dc supply voltages are measured under load (all cards installed) on the +5 power bus and test points E1 for +15 and E3 for -15; all are available with the bottom slide cover removed. Proceed to adjust the power supply module only if the measured voltages exceed the following limits:

- +5 measured from 4.90 Vdc to 5.10 Vdc
- +15 measured from 14.90 Vdc to 15.10 Vdc
- 15 measured from -15.10 Vdc to -14.90 Vdc

The adjustments are accessible with the protective cover removed from the end of the power supply.

4.2.2 ECL Power Supply

The ECL power supply is a dc to dc converter module mounted on A20. The fixed value resistor R1 determines the output voltage. Verify that the output (as measured at pin 5 of A/D Converter module on A1 Board - A1A1-5) is between -5.3 Vdc and -5.1 Vdc.

4.2.3 Crystal Oscillator

The crystal oscillator is also mounted on A20. The nominal frequency is 31.45728 MHz and should be between 31.457279 MHz and 31.457281 MHz. This can be determined either by direct measurement or by the use of the 350-6A/351A combination to measure a frequency standard of .1, 1, 2, or 5 MHz. Do this by inputting the known frequency, selecting that frequency on the center frequency switch, selecting translate ON, and selecting the 2 KHz frequency range. Set the 350-6A cursor at the input frequency and then adjust the crystal oscillator so the signal appears "bin centered" at the correct frequency.

4.2.4 A/D Converter Offset and Gain

The offset controls are not critical, their function is to avoid an offset large enough to effect dynamic range. The gain control function is to match the input level to the cursor amplitude measurement of the 350-6A.

- a. With no input and a selected 50 ohm internal input termination; A1R6 is adjusted for 0 Vdc (between -5 mV and +5 mV) on pins 9 and 10 of the A/D converter daughter card (see Figure 4.1).
- b. A/D converter module R18 is then adjusted for a minimum dc as measured by the 350-6A. (This measurement requires setting SW 4 on the A1 PWA to defeat the counterfrequency default software, setting the center frequency to 0000000 and translate ON. The A/D dc offset term then appears in the center of the display. The level should be set below -40 dB as read on the 350-6A amplitude cursor. Enable SW 4 when this adjustment is complete, the dc line will then be just off the left edge of the display as the Range/2 default is automatically selected for the center frequency.
- c. Connect a known amplitude signal to the 351A and select the termination required for that given amplitude. Select a frequency range greater than 3 times the frequency of the input (translate OFF) and adjust the input frequency to appear 'bin centered' on the display. Measure this amplitude with the 350-6A amplitude cursor. Any large (>2 dB) error noted at this point indicates a setup error, verify before proceeding. Adjust A/D converter module R29 so the amplitude readout matches the known input to within +/- .3 dB.

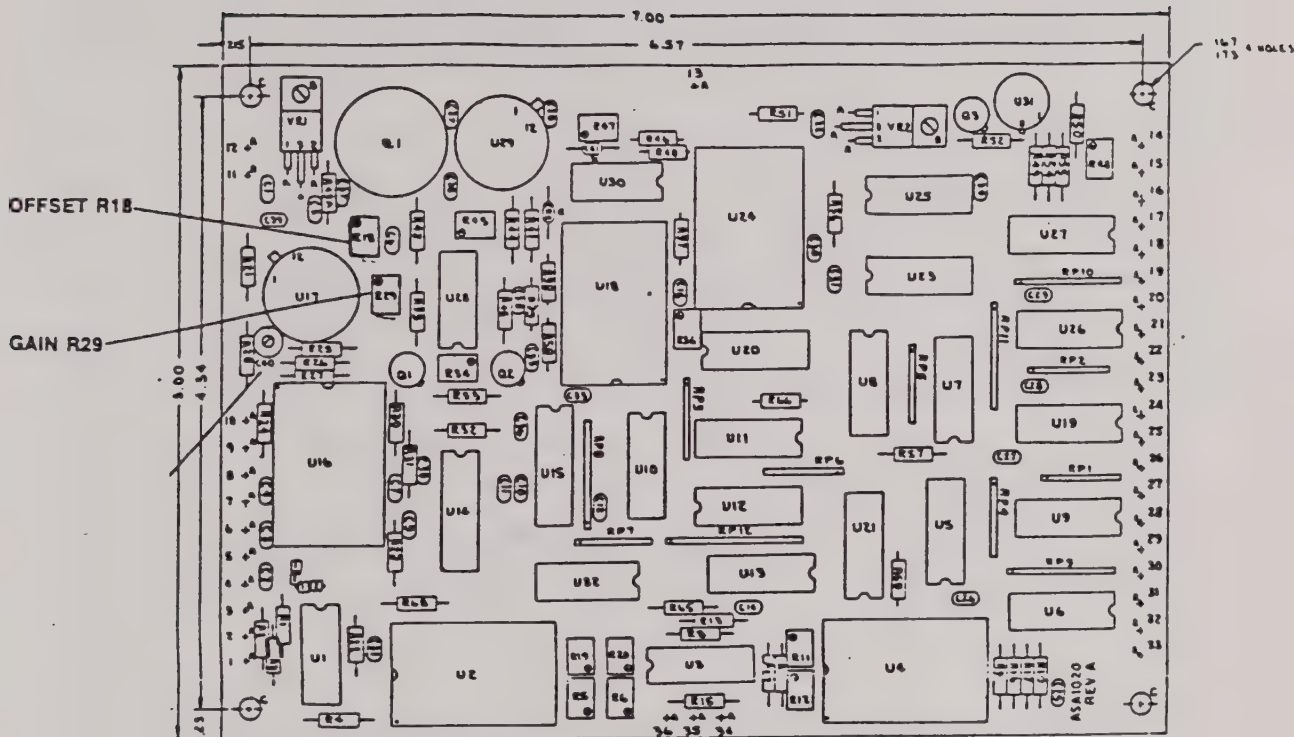


Figure 4.1. A/D Converter Daughter Card

4.2.5 Meter Drive Level

Set the input gain to 0 dB and input a 100m Vrms signal. Verfiy this signal reads -20 dB on the 350-6A amplitude cursor - the input meter should indicate the green band. Increase the input voltage slowly until the Overload LED is turned on. Adjust R3 so the needle is just into the red band. Now decrease the input voltage to its original level. The Overload LED should be off and the needle back in the green band.

4.3 Troubleshooting

Familiarity of the block diagrams of Section III, the Concept of Operation, and the general directions given here should allow isolation of malfunctions to the printed circuit card level. Isolation of problems to the component level is not supported. Schematics and interconnect wiring information are supplied to aid in understanding the card operations and the tracking of signals within the chassis interconnect. The 351A is assumed to be set up with a 350-6A and display for troubleshooting.

There are two basic sections in the 351A. One is the CPU which interfaces the front panel, the 350-6A controls, the GPIB interface, and then sets up the signal processing hardware accordingly. The other section is the signal processor which includes the A/D converter, the translator, the set of digital filters, and the buffer and timing circuits to route data to the 350-6A.

4.3.1 CPU Section

The CPU section is comprised of the CPU (A11), the CPU I/O (A10), and the CPU AUX Memory (A12). The CPU will indicate its simplest operation by illuminating the front panel ENABLE LED when it senses the proper 350-6A switch settings, i.e.,

Range	to	EXT
Expand	to	OFF/EXT
%Range	to	00.0 (EXT)
Magnify	to	EXT

This verifies basic operation of the interconnect cables and PWA A10 and A9. The CPU AUX Memory is involved only with GPIB data transfers; it may be installed or removed without affecting the operations discussed here. PWA A10 also senses the 351A front panel controls and (in tandem with the CPU) sets the signal processing hardware and sends range and center frequency data to the 350-6A calculator for the cursor frequency display. This operation can be verified by selecting various setups on the 351A and checking the 350-6A frequency cursor full scale and 'zero' values.

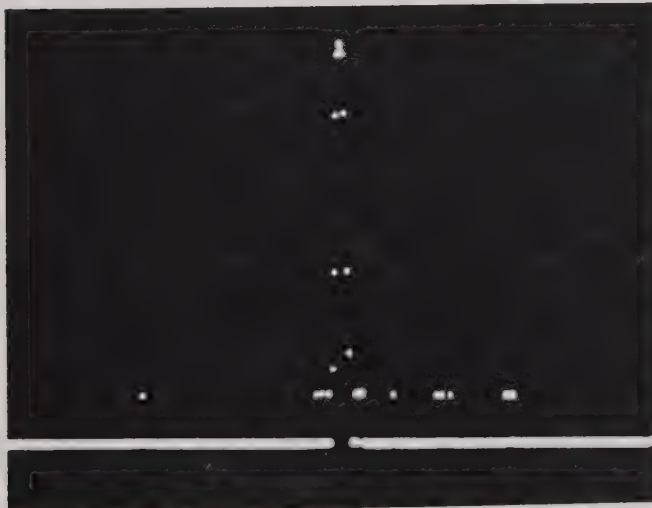
4.3.2 Signal Processing Section

This section is comprised of A1, the A/D converters; A2, the 'translator'; A4, A5, A6, and A7 the Digital Filters; and A8 the buffer. Also included are 'overhead' functions A9 the Timing, and A20 the ECL PS/OSC.

The ECL PS/OSC simply generates -5.2V for the A/D converter and generates 31.45728 MHz. The timing card uses the 31.45728 MHz to generate the 'CLOCK' signal for the processor cards. It also receives the CPU data and generates the digital filter microcontrol word. It also generates the required sequence of enables for the digital filters.

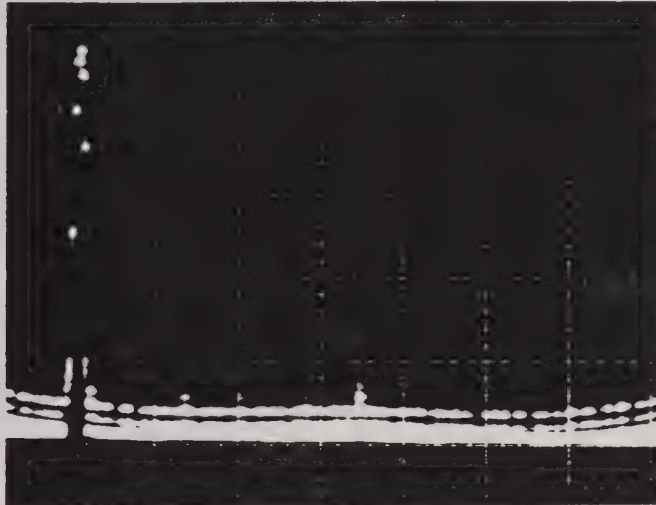
To aid in fault isolation of the remaining cards of the signal processing set, provisions have been designed in to bypass certain functions. The following steps will exercise the functions separately:

- a. Set SW 4 on the CPU (A11) to defeat the center frequency default (closed).
- b. Remove the A/D converter (A1).
- c. Ground TP1 on the buffer (A8) to bypass all digital filters.
- d. Ground TP1 on the translator (A3) to input (in lieu of A1) a large "dc" (zero frequency) signal.
- e. Set the center frequency to 0000000, the 350-6A display should be:



- f. As the center frequency is incremented, the 'dc' signal will move to the left. The distance it moves is a function of the range; it will always indicate 0 frequency on the 350-6A frequency cursor.

For a 351A setup of 1000000 Hz center frequency and a range of 3072 KHz, the display should be:

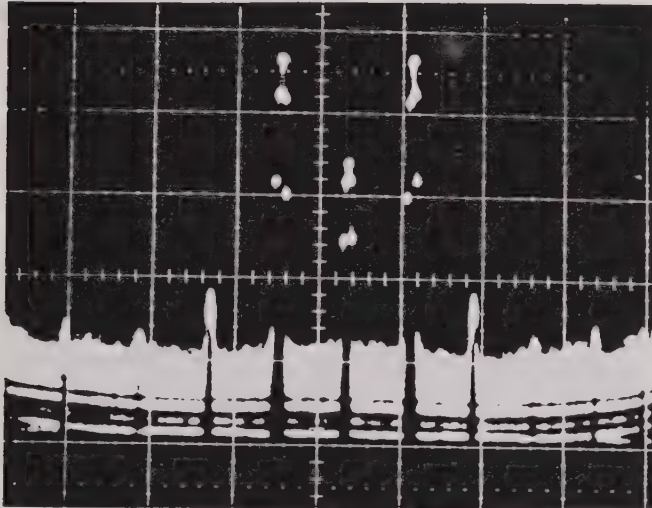


(This test verifies operation of the translator (A3) and buffer (A8.)

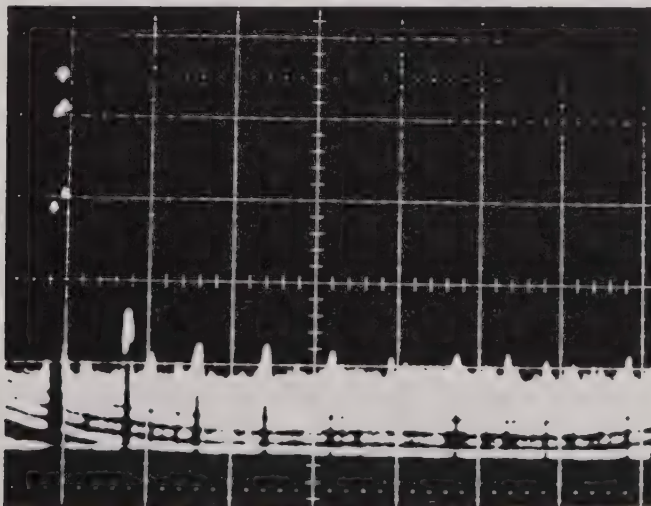
Note that aliasing can be introduced as no digital filters are present.

- g. Remove TP1 on A8 from ground. The operation is the same as steps (e) and (f), but aliasing cannot be introduced. All of the frequency ranges must be exercised to use all of the filters programmed into the digital filter cards.
- h. If step (g) indicates a problem, then observe the digital filter cards individually. They are selected by grounding TP1, TP2, TP3, or TP4 on A9 for digital filter cards A4, A5, A6, and A7. Since each digital filter is operating at one-fourth of the total rate, the signal as it appears on the 350-6A display will be offset by four times the amount as noted in steps (e) and (f).

- i. Remove TP1 on A3 from ground and reinstall the A/D converter (A1). Select the 6144 KHz range and a center of frequency of 0,000,000 Hz. Input a full scale signal at 500 KHz. The display should be similiar to:

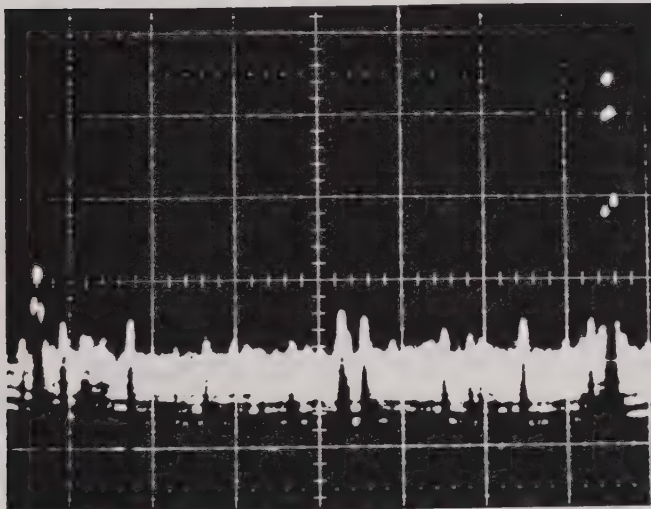


The A/D dc offset (in the center of the display, and measured at 0 frequency with the 350-6A cursor) should be greater than 40 dB below the signal. Now change SW 4 on A11 to enable the center frequency default operation. The display will become:



Verify that the signal amplitude is -20 dB. The second and third harmonics of the input should be greater than 50 dB below the signal. Spurious response should be greater than 55 dB below the signal.

Adjust the input frequency to 5 MHz. The second and third harmonics will grow but should remain greater than 40 dB below the signal. Since the A/D conversion is after the antialiasing filter, the distortion terms will fold back into the displayed spectrum as shown in the last photo.



4.4 Replaceable Parts and Assemblies

All repair parts for the GPD 351A Translator may be ordered directly from GPD. However, except for some specification - controlled parts which must be ordered from GPD, standard electronic parts have been used throughout the instrument. Table 4-1 provides a list of replaceable assemblies and chassis components.

When ordering a replacement part or assembly, be sure to include the reference designation, manufacturer's and/or GPD's part number, and a complete description, including the instrument name and model number, and instrument part number.

Table 4-1. Replaceable Assemblies and Parts

<u>Reference Designator</u>	<u>Name</u>	<u>Part Number</u>
A1	A/D CONVERTER PWA	40209000
A3	TRANSLATOR PWA	40202000
A4,A5,A6,A7	DIGITAL FILTER PWA	40201000
A8	BUFFER PWA	40211000
A9	TIMING PWA	40210000
A10	CPU I/O PWA	40206000
A11	CPU PWA	40208000
A12	CPU AUX MEMORY PWA	40207000
A20	ECL PS/OSC PWA	40216000
A22	FRONT PANEL ASSY	40203500
PS1	POWER SUPPLY ASSY	27969400

(PS1 is interchangeable with the power supply of the companion GPD 350-6A.)

Standard Parts

Power Cord - Belden PN 17250
Rear Panel 75-Pin Connectors - Elco PN 00-8026-075-491-805
Input Meter - S-A PN 21339100
Unkeyed Interconnect Cable (with keys for specific applications) - S-A PN 27021606

Location	Date	Time	Remarks
Point A	10/10/54	10:00	Clear sky, light breeze
Point B	10/10/54	10:15	Clear sky, light breeze
Point C	10/10/54	10:30	Clear sky, light breeze
Point D	10/10/54	10:45	Clear sky, light breeze
Point E	10/10/54	11:00	Clear sky, light breeze
Point F	10/10/54	11:15	Clear sky, light breeze
Point G	10/10/54	11:30	Clear sky, light breeze
Point H	10/10/54	11:45	Clear sky, light breeze
Point I	10/10/54	12:00	Clear sky, light breeze
Point J	10/10/54	12:15	Clear sky, light breeze
Point K	10/10/54	12:30	Clear sky, light breeze
Point L	10/10/54	12:45	Clear sky, light breeze
Point M	10/10/54	13:00	Clear sky, light breeze
Point N	10/10/54	13:15	Clear sky, light breeze
Point O	10/10/54	13:30	Clear sky, light breeze
Point P	10/10/54	13:45	Clear sky, light breeze
Point Q	10/10/54	14:00	Clear sky, light breeze
Point R	10/10/54	14:15	Clear sky, light breeze
Point S	10/10/54	14:30	Clear sky, light breeze
Point T	10/10/54	14:45	Clear sky, light breeze
Point U	10/10/54	15:00	Clear sky, light breeze
Point V	10/10/54	15:15	Clear sky, light breeze
Point W	10/10/54	15:30	Clear sky, light breeze
Point X	10/10/54	15:45	Clear sky, light breeze
Point Y	10/10/54	16:00	Clear sky, light breeze
Point Z	10/10/54	16:15	Clear sky, light breeze
Point AA	10/10/54	16:30	Clear sky, light breeze
Point AB	10/10/54	16:45	Clear sky, light breeze
Point AC	10/10/54	17:00	Clear sky, light breeze
Point AD	10/10/54	17:15	Clear sky, light breeze
Point AE	10/10/54	17:30	Clear sky, light breeze
Point AF	10/10/54	17:45	Clear sky, light breeze
Point AG	10/10/54	18:00	Clear sky, light breeze
Point AH	10/10/54	18:15	Clear sky, light breeze
Point AI	10/10/54	18:30	Clear sky, light breeze
Point AJ	10/10/54	18:45	Clear sky, light breeze
Point AK	10/10/54	19:00	Clear sky, light breeze
Point AL	10/10/54	19:15	Clear sky, light breeze
Point AM	10/10/54	19:30	Clear sky, light breeze
Point AN	10/10/54	19:45	Clear sky, light breeze
Point AO	10/10/54	20:00	Clear sky, light breeze
Point AP	10/10/54	20:15	Clear sky, light breeze
Point AQ	10/10/54	20:30	Clear sky, light breeze
Point AR	10/10/54	20:45	Clear sky, light breeze
Point AS	10/10/54	21:00	Clear sky, light breeze
Point AT	10/10/54	21:15	Clear sky, light breeze
Point AU	10/10/54	21:30	Clear sky, light breeze
Point AV	10/10/54	21:45	Clear sky, light breeze
Point AW	10/10/54	22:00	Clear sky, light breeze
Point AX	10/10/54	22:15	Clear sky, light breeze
Point AY	10/10/54	22:30	Clear sky, light breeze
Point AZ	10/10/54	22:45	Clear sky, light breeze
Point BA	10/10/54	23:00	Clear sky, light breeze
Point BB	10/10/54	23:15	Clear sky, light breeze
Point BC	10/10/54	23:30	Clear sky, light breeze
Point BD	10/10/54	23:45	Clear sky, light breeze
Point BE	10/10/54	24:00	Clear sky, light breeze

Summary of Survey Data - 10/10/54

Point A - 10:00 - Clear sky, light breeze

Point B - 10:15 - Clear sky, light breeze

Point C - 10:30 - Clear sky, light breeze

Point D - 10:45 - Clear sky, light breeze

Point E - 11:00 - Clear sky, light breeze

Point F - 11:15 - Clear sky, light breeze

Point G - 11:30 - Clear sky, light breeze

Point H - 11:45 - Clear sky, light breeze

Point I - 12:00 - Clear sky, light breeze

Point J - 12:15 - Clear sky, light breeze

Point K - 12:30 - Clear sky, light breeze

Point L - 12:45 - Clear sky, light breeze

Point M - 13:00 - Clear sky, light breeze

Point N - 13:15 - Clear sky, light breeze

Point O - 13:30 - Clear sky, light breeze

Point P - 13:45 - Clear sky, light breeze

Point Q - 14:00 - Clear sky, light breeze

Point R - 14:15 - Clear sky, light breeze

Point S - 14:30 - Clear sky, light breeze

Point T - 14:45 - Clear sky, light breeze

Point U - 15:00 - Clear sky, light breeze

Point V - 15:15 - Clear sky, light breeze

Point W - 15:30 - Clear sky, light breeze

Point X - 15:45 - Clear sky, light breeze

Point Y - 16:00 - Clear sky, light breeze

Point Z - 16:15 - Clear sky, light breeze

Point AA - 16:30 - Clear sky, light breeze

Point AB - 16:45 - Clear sky, light breeze

Point AC - 17:00 - Clear sky, light breeze

Point AD - 17:15 - Clear sky, light breeze

Point AE - 17:30 - Clear sky, light breeze

Point AF - 17:45 - Clear sky, light breeze

Point AG - 18:00 - Clear sky, light breeze

Point AH - 18:15 - Clear sky, light breeze

Point AI - 18:30 - Clear sky, light breeze

Point AJ - 18:45 - Clear sky, light breeze

Point AK - 19:00 - Clear sky, light breeze

Point AL - 19:15 - Clear sky, light breeze

Point AM - 19:30 - Clear sky, light breeze

Point AN - 19:45 - Clear sky, light breeze

Point AO - 20:00 - Clear sky, light breeze

Point AP - 20:15 - Clear sky, light breeze

Point AQ - 20:30 - Clear sky, light breeze

Point AR - 20:45 - Clear sky, light breeze

Point AS - 21:00 - Clear sky, light breeze

Point AT - 21:15 - Clear sky, light breeze

Point AU - 21:30 - Clear sky, light breeze

Point AV - 21:45 - Clear sky, light breeze

Point AW - 22:00 - Clear sky, light breeze

Point AX - 22:15 - Clear sky, light breeze

Point AY - 22:30 - Clear sky, light breeze

Point AZ - 22:45 - Clear sky, light breeze

Point BA - 23:00 - Clear sky, light breeze

Point BB - 23:15 - Clear sky, light breeze

Point BC - 23:30 - Clear sky, light breeze

Point BD - 23:45 - Clear sky, light breeze

Point BE - 24:00 - Clear sky, light breeze



MP MASTER



MA29853